MICRO-EPSILON

Operating Instructions

optoNCDT 1220

ILD 1220-10
ILD 1220-25
ILD 1220-50
ILD 1220-100
ILD 1220-200
ILD 1220-500

Intelligent laser optical displacement measurement

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Contents

1. Safety

Sensor operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in this operating instructions:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury
NOTICE	Indicates a situation that may result in property damage if not avoided.
➡	Indicates a user action.
i	Indicates a tip for users.
`Measure`	Indicates hardware or a software button/menu.

1.2 Warnings

⚠ CAUTION

Avoid unnecessary laser radiation to be exposed to the human body.

➡ Switch off the sensor for cleaning and maintenance.

➡ Switch off the sensor for system maintenance and repair if the sensor is integrated into a system.

Caution - use of controls or adjustments or performance of procedures other than those specified may cause harm.

Connect the power supply and the display/output device according to the safety regulations for electrical equipment.

> Risk of injury

> Damage to or destruction of the sensor

NOTICE

Avoid shocks and impacts to the sensor.

> Damage to or destruction of the sensor

Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted.
> Damage to or destruction of the sensor

The supply voltage must not exceed the specified limits.
> Damage to or destruction of the sensor

Protect the sensor cable against damage. Attach the cable load-free, hold the cable after appr. 25 cm e.g. zip tie.
> Destruction of the sensor

> Failure of the measuring device

Avoid constant exposure of sensor to splashes of water.
> Damage to or destruction of the sensor

Avoid exposure of sensor to aggressive media (detergents, cooling emulsions).
> Damage to or destruction of the sensor

1.3 Notes on CE Marking

The following apply to the optoNCDT 1220:
- EU Directive 2014/30/EU
- EU Directive 2011/65/EU, “RoHS“ category 9

Products which carry the CE mark satisfy the requirements of the EU directives cited and the relevant applicable harmonized European standards (EN). The measuring system is designed for use in industrial environments.

The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, article 10.

1.4 Intended Use

- The optoNCDT 1220 system is designed for use in industrial and laboratory applications.
- It is used
  - for measuring displacement, distance, position and thickness
  - for in-process quality control and dimensional testing
- The sensor must only be operated within the limits specified in the technical data, see Chap. 3.3.
- The sensor must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the controller.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class: IP65 (applies only when the sensor cable is plugged in)

Lenses are excluded from protection class. Contamination of the lenses leads to impairment or failure of the function.

- Temperature range:
  - Operation: 0 °C ... +50 °C (+32 ... +104 °F)
  - Storage: -20 °C ... +70 °C (-4 ... +158 °F)
- Humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure

The protection class is limited to water (no penetrating liquids, detergents or similar aggressive media).

2. Laser Safety

The ILD1220 sensors operate with a semiconductor laser with a wavelength of 670 nm (visible/red).
The sensors fall within Laser Class 2 (II). The laser is operated on a pulsed mode, the maximum optical power is ≤ 1 mW. The pulse frequency depends on the adjusted measuring rate (0.25 ... 1 kHz).
The pulse duration of the peaks is regulated depending on the measuring rate and reflectivity of the target and can be 0.3 ... 3999.6 µs.

Observe the laser protection regulations!

⚠ CAUTION

Laser radiation. Irritation or injury of the eyes possible. Close your eyes or immediately turn away if the laser beam hits the eye.

Although the laser output is low, directly looking into the laser beam must be avoided. Close your eyes or immediately turn away if the laser beam hits the eye. The housing of the optical sensors may only be opened by the manufacturer, see Chap. 10. For repair and service purposes, the sensors must always be sent to the manufacturer.

Lasers of Class 2 (II) are not subject to notification and a laser protection officer is not required.

The following warning labels are attached to the sensor cable.

Fig. 1 Laser labels on the sensor cable

Fig. 2 Laser warning sign on the sensor housing

During operation of the sensor the pertinent regulations according to IEC 60825-1 on „Safety of laser products“ must be fully observed at all times. The sensor complies with all applicable laws for the manufacturer of laser devices.

Laser operation is indicated by LED, see Chap. 5.3.

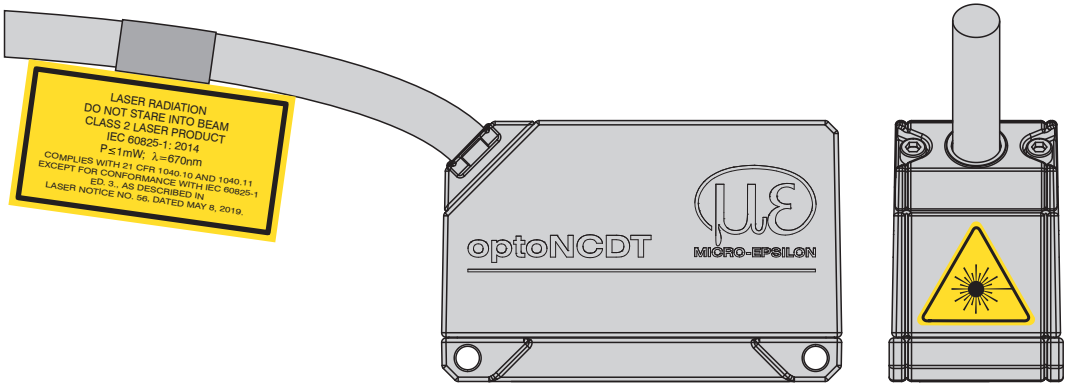


Fig. 3 Sensor cable and sensor with laser sign, ILD 1220

If both warning labels are covered over when the unit is installed, the user must ensure that supplementary labels are applied.

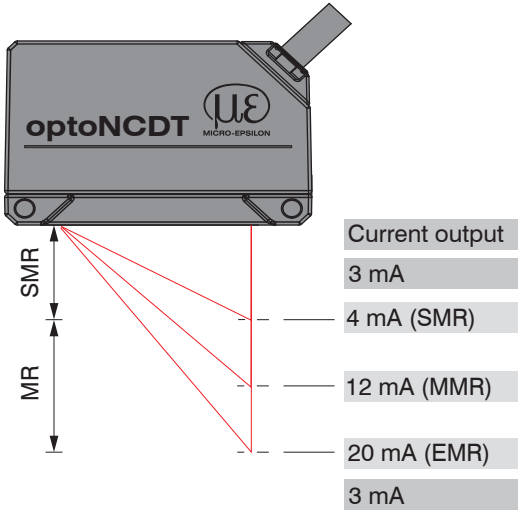
3. Functional Principle, Technical Data

3.1 Short Description

The optoNCDT 1220 uses the principle of optical triangulation, that is, a visible, modulated point of light is projected onto the target surface.

The diffuse part of the reflection of this point of light is displayed depending on distance on a position-resolving element (CMOS) by an receiver optic which is arranged to the optical axis of the laser beam in a defined angle.

A signal processor in the sensor calculates the distance of the point of light on the measuring object to the sensor by means of the output signal of the CMOS elements. The distance value is linearized and output by means of the analog interface.



MR = Measuring range
SMR = Start of measuring range
MMR = Mid of measuring range
EMR = End of measuring range

Fig. 4 Definition of terms

3.2 Auto Target Compensation (ATC)

The Auto Target Compensation (ATC) enables stable compensation independent of color and brightness of the measuring object. Also small objects can be detected reliably thanks to the small measuring spot.

3.3 Technical Data

					Available for OEM series		
Model		**ILD1220-10**	**ILD1220-25**	**ILD1220-50**	**ILD1220-100**	**ILD1220-200**	**ILD1220-500**
Measuring range		10 mm	25 mm	50 mm	100 mm	200 mm	500 mm
Start of measuring range		20 mm	25 mm	35 mm	50 mm	60 mm	100 mm
Mid of measuring range		25 mm	37.5 mm	60 mm	100 mm	160 mm	350 mm
End of measuring range		30 mm	50 mm	85 mm	150 mm	260 mm	600 mm
Measuring rate [1]		3 adjustable stages: 1 kHz / 0.5 kHz / 0.25 kHz					
Linearity		< ±10 µm	< ±25 µm	< ±50 µm	< ±100 µm	< ±200 µm	< ±750 ... 1500 µm
		< ±0.10 % FSO					< ±0.15% ... 0.30 % FSO
Repeatability [2]		3.7 µm	9.2 µm	18.4 µm	37 µm	74 µm	185 µm
Temperature stability		±0.015 % FSO / K			±0.01 % FSO / K		
Light spot diameter (±10%), [µm]	SMR	90 x 120	100 x 140	90 x 120	750 x 1100		
	MMR	45 x 40	120 x 130	230 x 240			
	EMR	140 x 160	390 x 500	630 x 820			
	smallest Ø	45 x 40 with 24 mm	55 x 50 with 31 mm	70 x 65 with 42 mm	-		
Light source		Semiconductor laser < 1 mW, 670 nm (red)					
Laser safety class		Class 2 in accordance with IEC 60825-1: 2014					
Permissible ambient light [3]		20,000 lx				7,500 lx	
Supply voltage		11…30 VDC					
Power consumption		< 2 W (24 V)					
Analog output		4 ... 20 mA (freely scalable within the measuring range)					

Switching output		1 x error output: npn, pnp, push pull
Connection		integrated cable 2 m, open ends, minimum bending radius 30 mm (fixed installation)
Mounting		Screw connection via two mounting holes
Temperature range	Operation	0 … +50 °C (+32 ... +122 °F) (non-condensing)
	Storage	-20 … +70 °C (-4 ... +158 °) (non-condensing)
Shock (DIN-EN 60068-2-29)		15 g / 6 ms in 3 axes, 1000 shocks each
Vibration (DIN-EN 60068-2-6)		20 g / 20 … 500 Hz in 3axes, 2 directions and 10 cycles each
Protection class (DIN-EN 60529)		IP65
Material		Aluminum housing
Weight		approx. 30 g (without cable), approx. 110 g (incl. cable)
Control and display elements		Select button: zero, teach, factory settings web interface for setup [4]; 2 x color LEDs for power / status

FSO = full scale output
SMR = start of measuring range, MMR = mid of measuring range, EMR = end of measuring range
The specified data apply to white, diffuse reflecting surfaces (Micro-Epsilon reference ceramic for ILD sensors)

1) Factory setting 1 kHz, modifying the factory settings requires the IF2001/USB converter (see accessories)

2) Measuring rate 1 kHz, median 9

3) Illuminant: light bulb

4) Connection to PC via IF2001/USB (see accessories)

4. Delivery

4.1 Unpacking, Included in Delivery

- 1 Sensor ILD 1220
- 1 Assembly instruction
- 1 Calibration protocol
- Accessories (2 pieces screw M2 and 2 pieces washer)

➪ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.

➪ Check the delivery for completeness and shipping damage immediately after unpacking.

➪ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

See Appendix for further accessories, see Chap. A 1.

4.2 Storage

Temperature range storage:	-20 ... +70 °C (-4 °F ... +158 °F)
Humidity:	5 - 95 % (non-condensing)

5. Installation

5.1 Notes for Operation

5.1.1 Reflection Factor of the Target Surface

In principle the sensor evaluates the diffuse part of the reflected laser light.

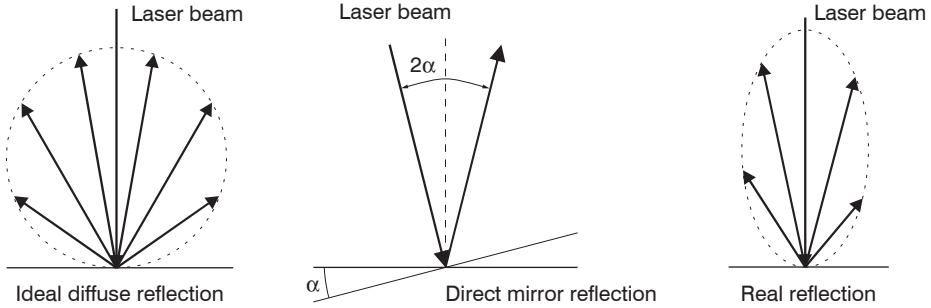


Fig. 5 Reflection factor of the target surface

A statement concerning a minimum reflectance is difficult to make because even a small diffuse fraction can be evaluated from highly reflecting surfaces. This is done by determining the intensity of the diffuse reflection from the CMOS signal in real time and subsequent compensation, see Chap. 3.2. Dark or shiny objects being measured, e.g. black rubber, may require longer exposure times. The exposure time is dependent on the measuring rate and can only be increased by reducing the sensor's measuring rate.

5.1.2 Error Influences

5.1.2.1 Light from other Sources

Thanks to their integrated optical interference filters the optoNCDT 1220 sensors offer outstanding performance in suppressing light from other sources. However, this does not preclude the possibility of interference from other light sources if the objects being measured are shiny and if lower measuring rates are selected. Should this be the case it is recommended to use suitable shields to screen the other light sources. This applies in particular to measurement work performed in close proximity to welding equipment.

5.1.2.2 Color Differences

Because of intensity compensation, color difference of targets affect the measuring result only slightly. However, such color differences are often combined with different penetration depths of the laser light into the material. Different penetration depths then result in apparent changes of the measuring spot size. Therefore color differences in combination with changes of penetration depth may lead to measuring errors.

5.1.2.3 Temperature Influences

When the sensor is commissioned a warm-up time of at least 20 minutes is required to achieve uniform temperature distribution in the sensor. If measurement is performed in the micron accuracy range, the effect of temperature fluctuations on the sensor holder must be considered. Due to the damping effect of the heat capacity of the sensor, sudden temperature changes are only measured with delay.

5.1.2.4 Mechanical Vibration

If the sensor is to be used for resolutions in the µm to sub-µm range, special care must be taken to ensure stable and vibration-free mounting of sensor and target.

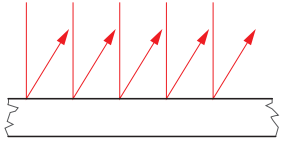
5.1.2.5 Movement Blurs

If the objects being measured are fast moving and the measuring rate is low, it is possible that movement blurs may result. Always select a high measuring rate for high-speed operations, therefore, in order to prevent errors.

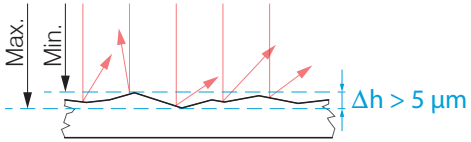
5.1.2.6 Surface Roughness

Laser-optical sensors detect the surface using an extremely small laser spot. They also track slight surface unevenness. In contrast, a tactile, mechanical measurement, e.g. using a caliper, detects a much larger area of the measurement object. In case of traversing measurements, surface roughnesses of 5 µm and more lead to an apparent distance change.

Suitable parameters for the averaging number may improve the comparability of optical and mechanical measurements.



Ceramic reference surface



Structured surface

Recommendation for parameter choice:

- The averaging number should be selected in such a way that a surface area the size of which is comparable to those with mechanical measurements is averaged.

5.1.2.7 Angle Influences

Tilt angles of the target in diffuse reflection both around the X and the Y axis of less than 5 ° only have a disturbing effect with surfaces which are highly reflecting.

These influences have to be explicitly considered when scanning profiled surfaces. Basically the angle behavior of triangulation is liable to the reflectivity of the measuring object surface.

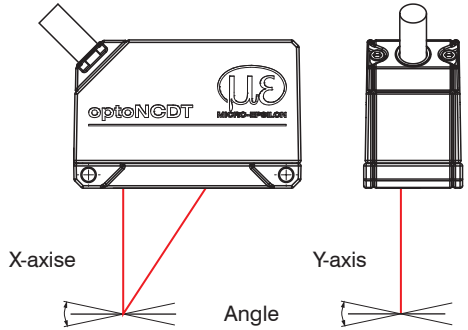
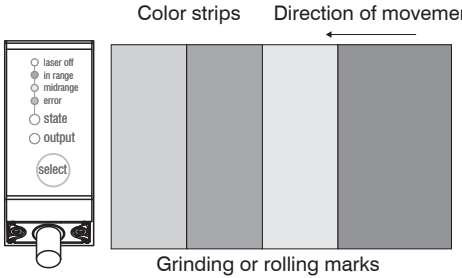


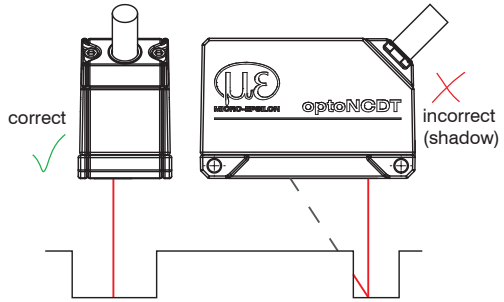
Fig. 6 Measurement errors through tilting with diffuse reflection

5.1.3 Optimizing the Measuring Accuracy



In case of rolled or polished metals that are moved past the sensor the sensor plane must be arranged in the direction of the rolling or grinding marks. The same arrangement must be used for color strips.

Fig. 7 Sensor arrangement in case of ground or striped surfaces



In case of bore holes, blind holes and edges in the surface of moving targets the sensor must be arranged in such a way that the edges do not obscure the laser spot.

Fig. 8 Sensor arrangement for holes and ridges

5.2 Mounting, Dimensions

The optoNCDT 1220 sensor is an optical system for measurements with micrometer accuracy. The laser beam must be directed perpendicularly onto the surface of the target. In case of misalignment it is possible that the measurement results will not always be accurate.

i Make sure it is handled carefully when installing and operating.

➡ Mount the sensor by means of 2 screws type M3 or by means of through bores for M2 with the screws from the accessories.

Bolt connection					
Through length	**Screw depth**	**Amount**	**Screw**	**Washer**	**Torque**
20 mm	min 5 mm	2	M2 x 25 ISO 4762-A2	A2.2 ISO 7089-A2	0.5 Nm (μ = 0.12)
	min 4.8 mm, max 20 mm	2	M3 ISO 4762-A2		1 Nm (μ = 0.12)
Direct fastening					

Fig. 9 Mounting conditions

The bearing surfaces surrounding the fastening holes (through-holes) are slightly raised.

i Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted. Do not exceed torques.

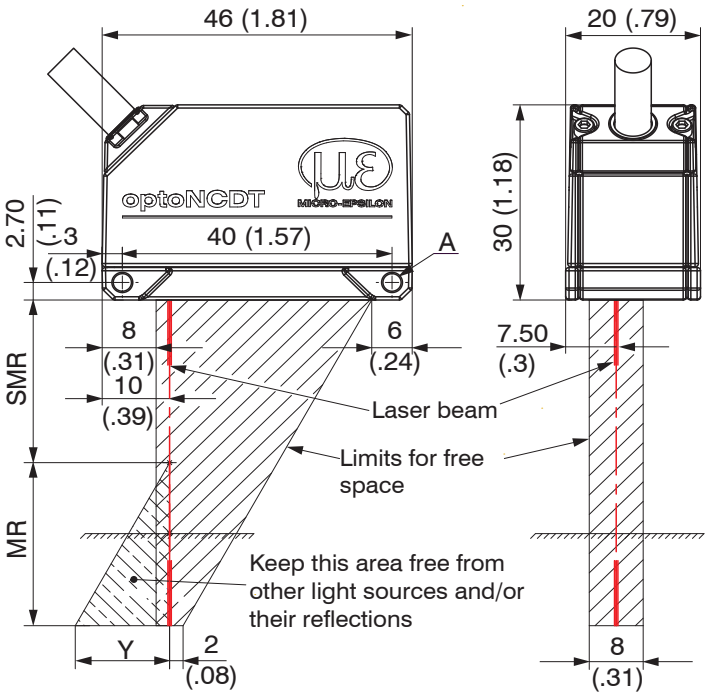


Fig. 10 Dimensional drawing and free space for optics and optical free space

ILD 1220-		10	25	50	100	200	500
MR	mm	10	25	50	100	200	500
SMR	mm	20	25	35	50	60	100
EMR	mm	30	50	85	150	260	600
Y	mm	10	21	28	46	70	90

The indicated free space in the reception area, see Fig. 10, has to be kept clear from foreign objects and extraneous light of other laser sensors at least until the end of measuring range.

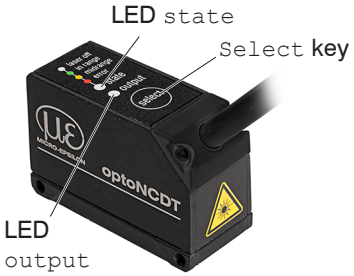
MR = Measuring range
SMR = Start of measuring range
MMR = Mid of measuring range
EMR = End of measuring range
FSO = Full scale output

A: 2x M3 for direct fastening or
2x M2 for bolt connection

5.3 Indicator Elements at Sensor

LED State	Meaning
green	Measuring object within sensor range
yellow	Mid range
red	Error - e.g. Poor target or out of range
off	Laser off

LED Output	Meaning
green	---
yellow	The current output is switched off.
red	Current 4 ... 20 mA measurement value output
off	Sensor off, no supply



The programmable touch key `select` calls up the functions `Reset`, `Teaching` or `zeroing`. By factory default this key is only active for the first 5 minutes after power up. After that it will be automatically locked.

5.4 Electrical Connections

5.4.1 Connection Possibilities for Parametrization

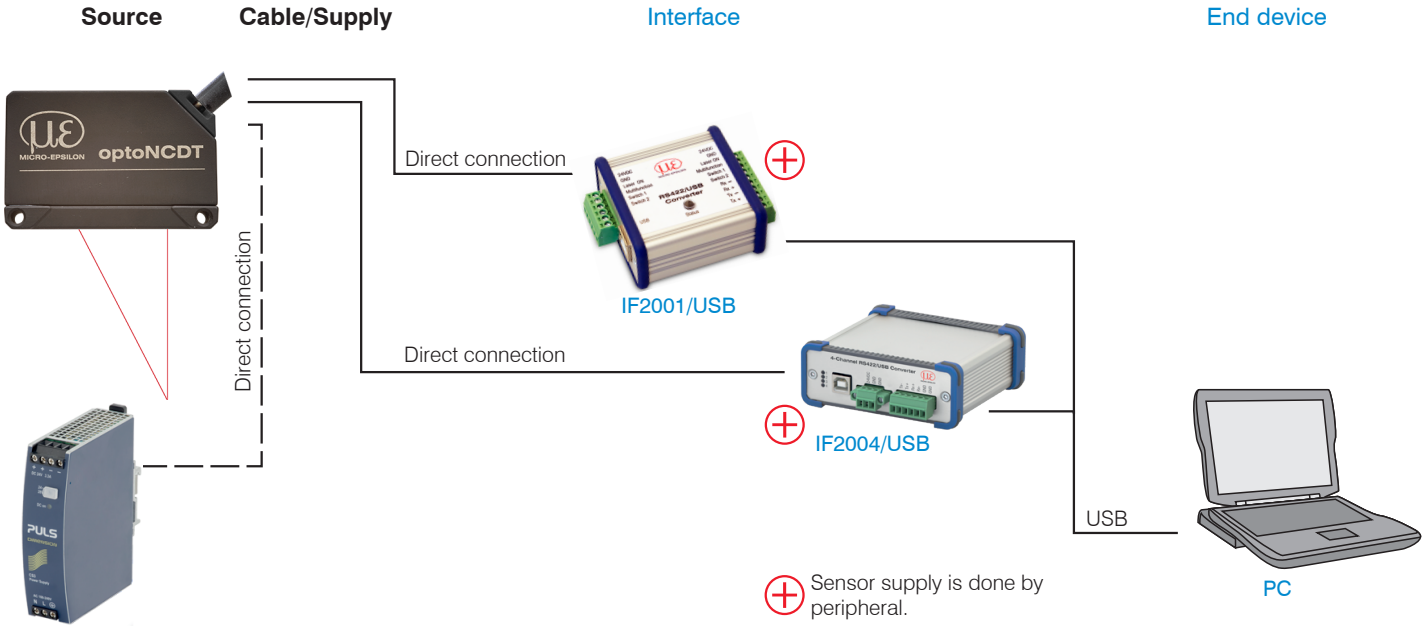


Fig. 11 Connection examples on ILD 1220

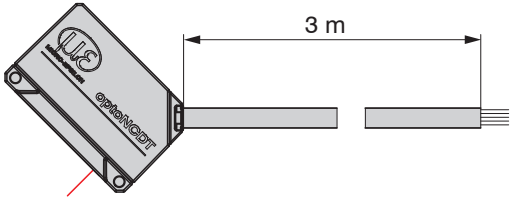
The different periphery devices can be connected to the sensor by the illustrated connections, see Fig. 11. The converters IF2001/USB and IF2004/USB also supply the operating voltage (24 V DC) of the sensor. Power to the converters is supplied e. g. by the optional power supply PS 2020.

Peripheral	Sensor channels	Interface
IF2001/USB, RS422 USB converter	one	RS422 [1]
IF2004/USB	one	
SPS, ILD 1220 or the like	---	Functional input: trigger
Switch, key, PLC or the like	---	Switching input laser On/Off

Fig. 12 Max. sensor channels on the peripheral devices

1) The digital interface is used for sensor parametrization only.

5.4.2 Pin Assignment



The shielding of the cable is connected to the sensor housing. The sensor cable is not cable carriers suitable. One end is molded on the sensor, the other end has free leads with ferrules.

ILD1220 with open ends

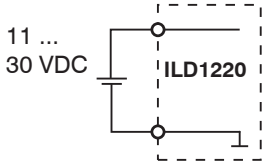
Signal	Color sensor cable	Description	Specification, Wiring
RS422 Rx+	green	Serial input	Internally terminated with 120 Ohm
RS422 Rx-	yellow		
RS422 Tx+	gray	Serial output	Terminate externally with 120 Ohm
RS422 Tx-	pink		
$+U_B$	red	Supply voltage	11 ... 30 VDC, typ. 24 VDC, P < 2 W
Laser on/off	black	Switch input	Laser is active, if input is connected with GND
Functional input	violet		Trigger, Zero, Teaching
Error	brown	Digital output	I_{max} = 100 mA, U_{max} = 30 VDC, Programmable switching characteristic: (NPN, PNP, Push-Pull)
I_{OUT}	white	4 ... 20 mA	R_{Load} = 250 Ohm: U_{OUT} 1 ... 5 V with U_B > 11 V R_{Load} = 500 Ohm: U_{OUT} 2 ... 10 V with U_B > 17 V
GND	blue	Ground potential	Supply and signal ground
Connector housing	Shield	Sensor housing	Connect with potential equalization

5.4.3 Supply Voltage

Nominal value: 24 V DC (11 ... 30 V, P < 2 W).

➡ Only turn on the power supply after wiring has been completed.

➡ Connect the inputs “red“ and “blue“ at the sensor with a 24 V voltage supply.



Wire color	Supply
red	$+U_B$
blue	Ground

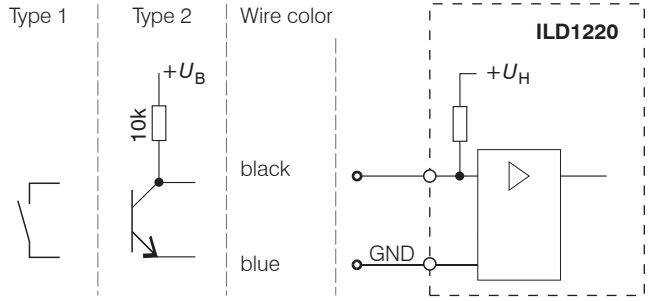
Use the supply voltage for measurement instruments only and not for drive units or similar sources of pulse interference at the same time.
MICRO-EPSILON recommends using an optional available power supply unit PS2020 for the sensor.

Fig. 13 Connection of supply voltage

5.4.4 Laser on

The measuring laser on the sensor is activated via an HTL switch input. This is advantageous if the sensor has to be switched off for maintenance or similar. Switching can be done with a transistor (for example open collector in an optocoupler) or a relay contact.

i If the black and blue wire are not connected, the laser is off.



There is no external resistor for current limiting required. Connect the black wire with the blue wire for permanent „Laser on“.

Reaction Time for Laser-On: Correct measuring data are sent by the sensor approximately 1 ms after the laser was switched on.

Fig. 14 Electrical wiring for laser off

5.4.5 RS422 Connection with USB Converter IF2001/USB

The digital interface is used for sensor parametrization only. Cross the lines for connections between sensor and PC.

i Disconnect or connect the D-sub connection between RS422 and USB converter when the sensor is disconnected from power supply only.

Sensor		End device (converter) Type IF2001/USB from MICRO-EPSILON
Signal	Sensor cable	
Tx +	grey	Rx + (Pin 3)
Tx -	pink	Rx -(Pin 4)
Rx +	green	Tx + (Pin 1)
Rx -	yellow	Tx -(Pin 2)
GND	blue	GND (Pin 9)

Symmetric differential signals acc. to EIA-422, not galvanically isolated from supply voltage.

Use a shielded cable with twisted cores.

Fig. 15 Pin assignment IF2001/USB

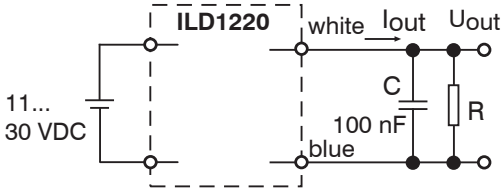
5.4.6 Analog Output

The sensor provides a current output 4 ... 20 mA.

i The output may not be continuously operated in short circuit operation without load resistor. The short circuit operation leads to durable thermal overload and thus for automatic overload shutdown of the output.

➡ Connect the white and the blue wire on the sensor to a measuring device.

Sensor	
Signal	Sensor cable
I_{OUT}	white
GND	blue



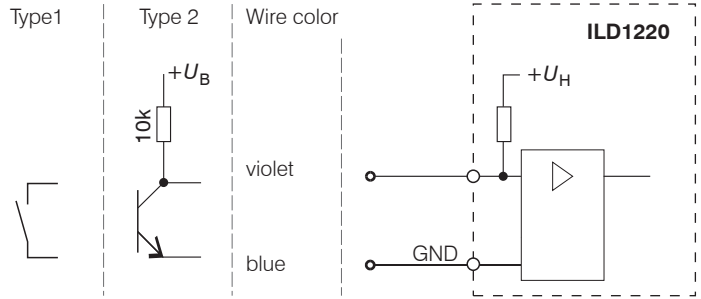
With the adjacent circuit you will get an analog voltage output in the range of 1 ... 5 V.

R = 250 Ohm:
U_{OUT} 1 ... 5 V at U_B > 11 V
R = 500 Ohm:
U_{OUT} 2 ... 10 V at U_B > 17 V

Fig. 16 Wiring for voltage output

5.4.7 Multifunctional Input

The multifunctional input enables the functions Triggering, Zeroing and Teaching. The function is dependent on the programing of the input and of the time behavior of the input signal.



Input is not galvanically isolated.

24V logics (HTL):
Low level≤ 2 V
High level≥ 8 V (max 30 V),

Internal pull up resistance, an open input is noticed as High.

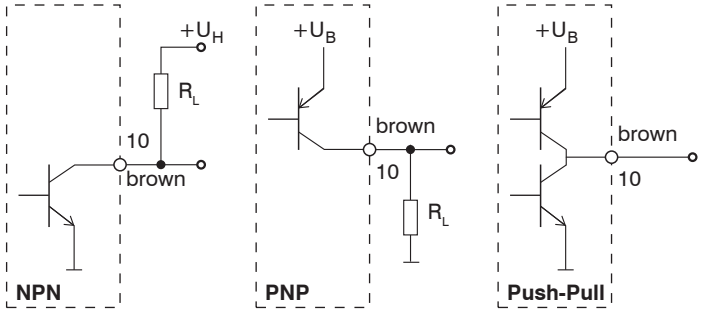
Connect the input with GND to trigger the function.

Fig. 17 Electrical wiring for multifunctional input

5.4.8 Digital Output

The switching characteristic (NPN, PNP, Push-Pull, Push-Pull negated) of the digital output (Error) depends on the programing.

The NPN output is e.g. suitable for adjustment to TTL logics with an auxiliary voltage U_H= +5 V. The digital output is protected against reverse polarity, overloading (< 100 mA) and over temperature.



Output is not galvanically isolated.

24V logics (HTL),

I_{max} = 100 mA,

U_{Hmax} = 30 V saturation voltage at I_{max} = 100 mA:

Low < 2.5 V (output - GND),

High < 2.5 V (output - $+U_B$)

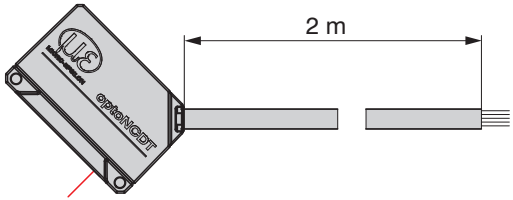
Fig. 18 Electrical wiring digital output

Switching characteristic		
Description	**Output active (error)**	**Output passive (no error)**
NPN (Low side)	GND	appr. $+U_H$
PNP (High side)	$+ U_B$	appr. GND
Push-Pull	$+ U_B$	GND
Push-Pull, negated	GND	$+ U_B$

Fig. 19 Switching characteristic *digital output*

The digital output is activated when measuring object is missing, measuring object too close/too far or when no valid measurement value can be determined.

5.4.9 Sensor Cable



ILD 1220 with open ends

➡ Never fall below the bending radius for the sensor cable of 30 mm (fixed) or 60 mm (dynamic).

i The fixed connected sensor cables are not cable carriers suitable.

i Unused open cable ends must be insulated to protect against short circuits or malfunction of the sensor.

➡ Avoid excessive pulling to the cables. Provide strain relieves near the connectors when cables > 5 m are vertically free hanging.

➡ Connect the cable shield to the potential equalization (PE, protective earth conductor) on the evaluator (control cabinet, PC housing) and avoid ground loops.

➡ Never lay signal leads next to or together with power cables or pulse-loaded cables (e.g. for drive units and solenoid valves) in a bundle or in cable ducts. Always use separate ducts.

Recommended strand cross-section for self-made connection cables: ≥ 0.14 mm² (AWG 25).

6. Operation

6.1 Getting Ready for Operation

- Install and assemble the optoNCDT 1220 in accordance with the instructions set out, see Chap. 5.
- Connect the sensor with the indicator or monitoring unit and the power supply.

The laser diode in the sensor can only be activated if at the input Laser on/off Pin 8 is connected with Pin 12, see Chap. 5.4.4.

Once the operating voltage has been switched on the sensor runs through an initialization sequence. This is indicated by the momentary activation of all the LEDs. Once initialization has been completed, the sensor transmits a „->“ via the RS422 interface. The initialization takes up to 10 seconds. Within this period, the sensor executes the `Reset` or the `Bootloader` command through the key `select` only.

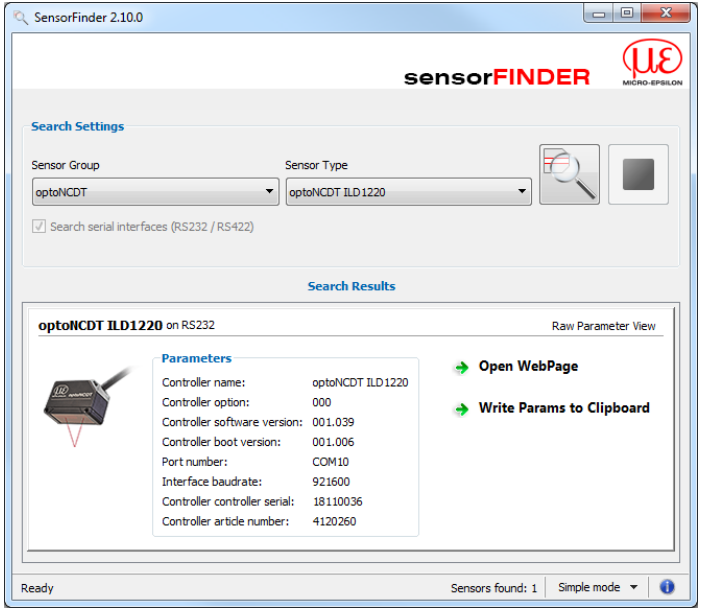
To be able to produce reproducible measurements the sensor typically requires a start-up time of 20 minutes.

If the LED `output` is off, this means that there is no supply voltage.

If the LED `state` is off, this means that the laser light source has been switched off.

6.2 Parameterizing via Web Interface

6.2.1 Preconditions



In the sensor, dynamic Web pages are created that contain the current settings of the sensor and the periphery. The operation is only possible as long as an RS422 connection to the sensor exists.

The sensor is connected to a PC/notebook via a RS422 converter, supply voltage persists.

➡ Start the program `sensorFINDER V2.1x.x`.

Fig. 20 Auxiliary program for sensor search and to start web interface

The tool searches for connected ILD 1220 sensors on available interfaces.

You need a web browser (e.g. Mozilla Firefox or Internet Explorer) on a PC/notebook.

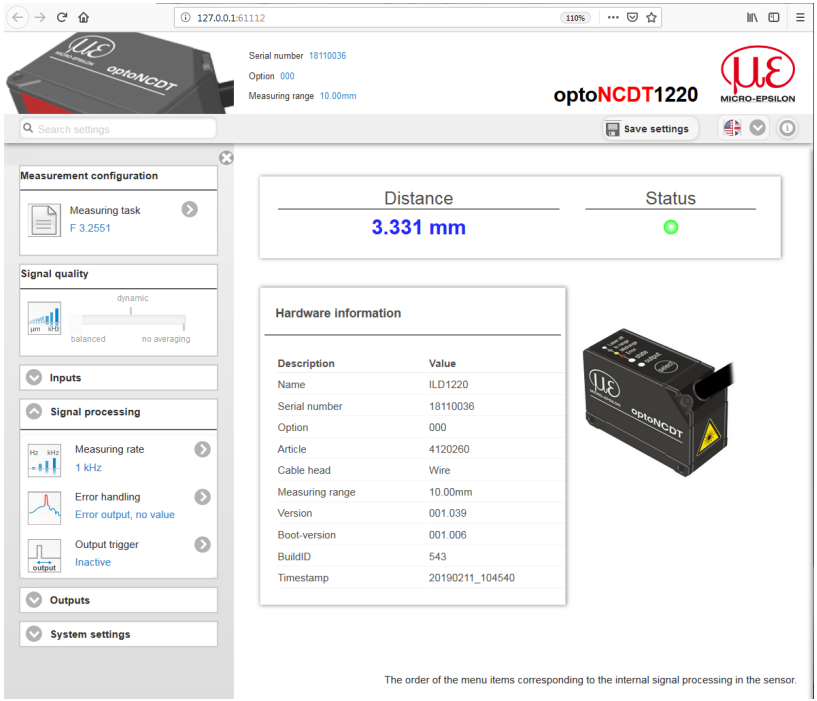
➡ Choose the desired sensor. Click on the button `Open WebPage`.

The web browser starts and then loads the sensor's web interface homepage.

6.2.3 Access via Web Interface

Start the web interface of the sensor, see Chap. 6.2.1.

Interactive websites for programming the sensor now appear in the web browser.

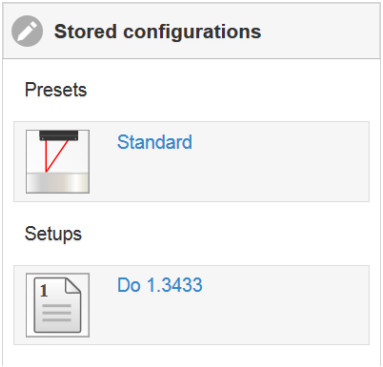


The appearance of the websites can change dependent of the functions. Each page contains descriptions of parameters and so tips for filling the website.

The sensor is active and supply measurements with a low output rate.

Fig. 21 First interactive website after selection of the web interface

By clicking the button in the area `Measurement configuration`, the change between the saved configurations (presets) for different measuring object surfaces (targets) is done. Choosing a target causes a predefined configuration of the settings which achieves the best results for the chosen material. In delivery state, only the `Standard` preset is available.



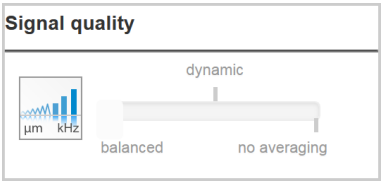
Preset Standard

The measuring configuration is factory-set for ceramics and metals.

Setups

You can store the measuring settings in a setup and activate them in the sensor at any time.

If you use the `Standard` preset, changes on the settings are possible with the `Signal quality` slider.



Averaging

balanced
moving, 64 values

dynamic
Median, 9 values

no averaging

Description

In the area `Signal quality` you can switch between three given basic settings (balanced, dynamic and no averaging).

The area `System configuration` displays the current settings e. g. for unit and access authorization in blue lettering.

i After programming all the settings are to be stored permanently in a set of parameters. The next time you turn on the sensor they are available again. Therefore use the button `Save settings`.

6.3 Timing, Measurement Value Flux

The sensor requires three cycles for measurement and calculation without triggering:

Each cycle takes 1000 µs at a measuring rate of 1 kHz. The measured value N is available at the output after three cycles. The delay between acquisition and output is therefore 3000 µs. As the processing in the cycles occurs parallel, after another 1000 µs, the next measured value (N+1) is output.

7. Set Sensor Parameter

7.1 Preliminary Remarks to the Adjustments

You can program the optoNCDT 1220 using the sensorFINDER tool and the Web interface.

i If you do not save the programming permanently in the sensor, you lost the settings after turning off the sensor.

7.2 Overview Parameter

The following parameters can be set or changed in the optoNCDT 1220, see tab `Settings`.

Inputs	Multifunction input, Key function
Signal processing	Measuring rate, Error handling, Triggering (Data output)
Outputs	RS422, Analog output, Switching output
System settings	Unit on website, Key lock, Load & Store, Import & Export, Access authorization, Sensor reset (factory settings)

7.3 Inputs

7.3.1 Overview Functions

➪ Go to the `Settings` menu.

Multifunctional input	*Zeroing*	*High / Low*	*Sets the function of the switching input. The Trigger influences export of a measurement value. Zeroing set the current measurement value to half of the analog output values. Teaching scales the analog output. HTL is defined as active input level.*
	Trigger In	*High / Low*	
	Teaching		
	Inactive		
Key function	*Zeroing*		*Sets the function of the sensor key. Inactive means keylock.*
	Teaching		
	Inactive		

7.3.2 Zeroing

The zero setting function set the output value to half of the analog output values or to zero (digital value in the web interface). The output range is moved thereby. This function makes sense, for example, for several adjacent measuring sensors or in the case of the thickness and planarity measurement.

Zero setting is used to compensate mechanical tolerances in the measurement setup of the sensors or for relative measurements. When zeroing the sensor‘s characteristic is parallel displaced.

Sequence for Zeroing:

➪ Bring target and sensor in the desired position together.

➪ Trigger the zero setting function via the hardware input or the button on the sensor.

After zero setting, the sensor will provide new readings relative to the measurement value during zero setting.

i `Zeroing` requires that a target is within the measurement range.
`Zeroing` has an influence on the analog and digital output.

7.3.2.1 Zeroing with Select Key

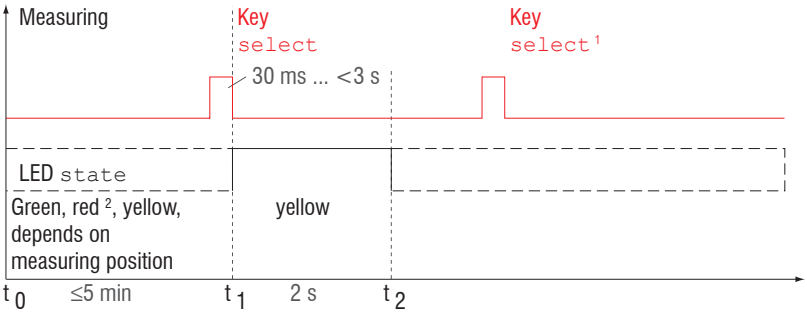


Fig. 23 Flow chart for zeroing (key select)

The key Select is locked according to factory settings after expiry of 5 min. You can unlock the keylock e.g. via the web interface, see Chap. 7.6.3.

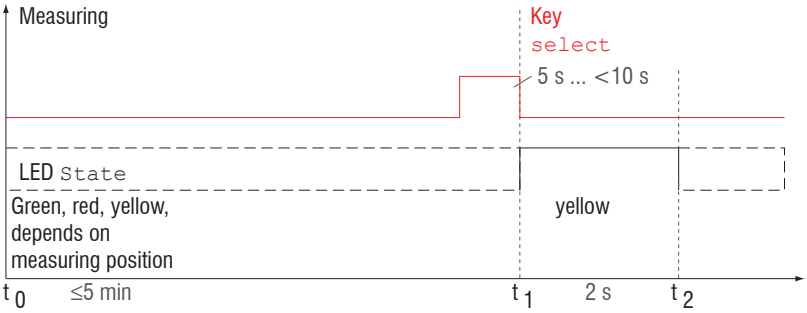


Fig. 24 Flow chart for the return of zero setting

The function Zeroing can be used several times in succession. Between repetition of the function Zeroing a brake of 1 s is necessary. The function Zeroing can also be combined with the multifunctional input.

1) The key Select remains without effect since key lock is active.

2) The zeroing is not applied when LED State is red, flash frequency 8 Hz for 2 s.

7.3.2.2 Zeroing with Hardware Input

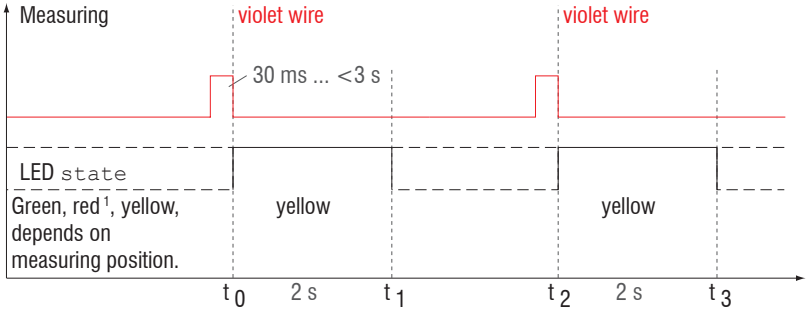


Fig. 25 Flow chart for zeroing (hardware input)

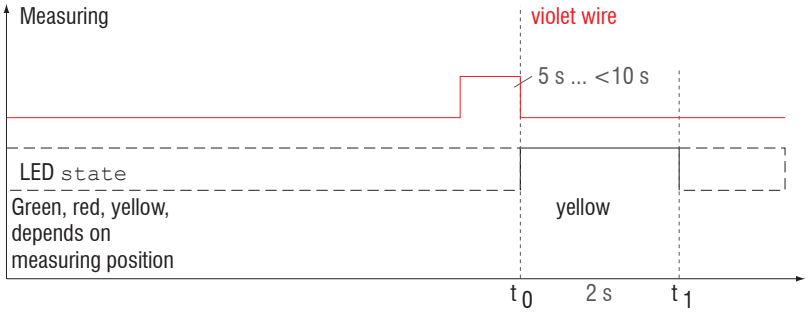


Fig. 26 Flow chart for the return of zero setting

A pulse can be made via the functional input (violet wire sensor cable).
Details of the hardware input can be found in the electrical connections, see Chap. 5.4.7.

The function zeroing can be applied successive in several times. Between repeating the zeroing function a pause of 1 s is required. The zeroing function can also be combined with the `select` key.

1) The zeroing is not applied when LED `State` is red, flash frequency 8 Hz for 2 s.

7.4 Signal Processing

7.4.1 Preliminary Remark

➡ Go to the menu `Signal processing` in the vertical navigation.

In the right part of the display you can find references to the chosen setting.

All settings are applied immediately.

7.4.2 Measuring Rate

The measuring rate indicates the amount of measurements per second.

➡ Choose the desired measuring rate.

Measuring rate	*250 Hz / 500 Hz / 1 kHz*	*Use a high measuring rate with light and matt measuring objects. Use a low measuring rate with dark and shiny measuring objects (e.g. black lacquered surfaces) to improve the measuring result.*

With a maximum measuring rate of 1 kHz the CMOS element is exposed 1000 times per second. The lower the measuring rate, the higher maximum exposure time.

Measuring rate is set to 1 kHz ex works.

7.4.3 Error Handling

Error handling adjusts the behavior of the analog output and the RS422 interface in the event of an error.

Error handling	*Error output, no value*	*Analog output supplies 3 mA instead of the measurement value. The RS422 interface outputs an error value.*	
	Retain last value infinitely	*Analog output and RS422 interface stick to the latest valid value.*	
	Retain last value	*1 ... 1024*	*Value*

If no valid measurement value can be detected, an error is output. If this disrupts further processing, you can alternatively hold the last valid value over a specific period of time i.e. it can be output again. After expiry of the chosen number an error value is output.

7.4.4 Triggering

7.4.4.1 General

The optoNCDT 1220 measurement output is controllable through an external trigger signal or a command. Triggering affects the analog and digital output. The measurement value at the time of triggering is output delayed, see Chap. 6.3.

- Triggering does not influence the timing so that between the trigger event (level change) and the start of output always lie 3 cycles + 1 cycle (Jitter).
- The multifunctional input is used as external trigger input, see Chap. 5.4.7.
- Factory setting: no triggering, the sensor starts data transmission right after start-up.
- Pulse duration of the “Trigger in“ signal must be at least 50 µs.

Output trigger	*Level*				*A continuous measurement task is following as long as the chosen level remains the same. Choice of level, see Chap. 7.3. Pulse duration must be at least a cycle time. The following pause must be at least a cycle time..*
	Edge	*infinite*			*Edge selection, see Chap. 7.3. “0“ end trigger, “1 ... 16382“ values per trigger, “16383“ endless trigger*
		manual	*Number*	*Value*	
	Inactive				*No triggering*

Valid with triggering:

$f_T < f_M$ f_T Trigger frequency

f_M Measuring rate

Implemented trigger conditions:

Level triggering with high level / low level.
Continuous measurement input or output, as long as the selected level is applied. Then stops the data output.

The pulse duration must be at least one cycle time. The subsequent break must also be at least one cycle time.

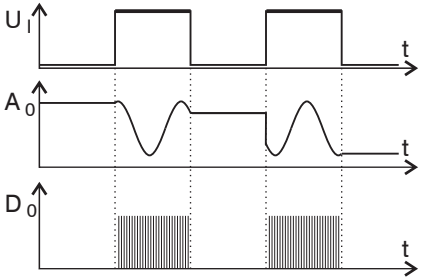


Fig. 27 High trigger level (above) with analog output A_0 and digital output signal D_0 (below)

Edge triggering with rising or falling edge.

Starts measured value acquisition or output as soon as the chosen edge is applied to the trigger input. The sensor outputs a fixed number of measurement values when trigger conditions have been met. Value range from 1 ... 16383. After termination of data output the analog output sticks to the last value (sample & hold).

Pulse duration must be at least 50 µs.

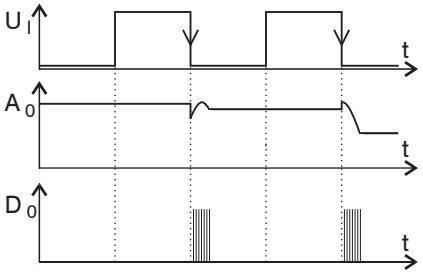


Fig. 28 Trigger edge HL (above) with analog output A_0 and digital output signal D_0 (below)

7.4.4.2 Value Output Trigger

Measurement values are calculated continuously and independently of the trigger event. A trigger event simply triggers the value output via a digital interface. Therefore, any values measured immediately before the trigger event are included in calculating mean values (averages).

7.5 Outputs

7.5.1 Overview

RS422 [1]	Baud rate	*9.6 / 19.2 / 56.0 / 115.2 / 230.4 ... / 1000 kBps*		*Transmission rate with binary data format.*
Analog output	*Standard scale*			*Start of measuring range 4 mA, end of measuring range 20 mA*
	Two-point scale	*Minimum value*	*Value*	*Always 2 points which mark the start and end of a new measuring range are taught. Reversal of the output signal is possible with two-point scaling.*
		Maximum value	*Value*	
Switching output	Inactive			
	Measuring range	*NPN / PNP / PushPull / PushPullNeg*		*The switching output is switched when the received signal is not (entirely) in evaluation range (ROI).*
	Analog range	*NPN / PNP / PushPull / PushPullNeg*		*The switching output switches when the scaled analog range is exceeded.*
	Limit monitoring	*NPN / PNP / PushPull / PushPullNeg*		*The error output switches when the limit value is exceeded.*
		Limit mm/inch	*Value*	
		Hysteresis mm/inch	*Value*	*Value by which the measured value must fall short of the limit value to deactivate the switching output.*
		Minimum holding period	*Value*	*Indicates in 1 ... 1000 ms how long the switching output must be active at least when the limit value is exceeded. This time period starts when the limit value is exceeded.*

1) The digital interface is used for sensor parametrization only.

The measurement values are output in parallel both via the analog output and with low output rate via the web interface.

7.5.2 Analog Output Scaling

7.5.2.1 Output Scaling

- Max. output range: 4 mA ... 20 mA
- Output gain ΔI_{OUT}: 16 mA = 100 % MR
- Error value: 3.0 mA (±10 µA)

The teaching scales the analog output (4 to 20 mA) for a part of the measuring range. This allows you to optimize the resolution for the analog measurement range. Only the current and error output will be affected by the 2 point calibration. Therefore you define a new start and end for the measurement range. This teaching procedure can be performed live via the `select` key, the `multifunctional input` or via the webinterface.

i With a user defined output scaling you can use the error output, see Chap. 5.4.8, as a programmable limit switch.

The measurement object positions for `Teach 1` (minimum value) and `Teach 2` (maximum value) have to differ from each other.

The teaching process requires a valid measuring signal. The teaching process is terminated at

- no target,
- target not evaluated,
- to close to the sensor - beyond SMR or
- to far from the sensor - beyond EMR.

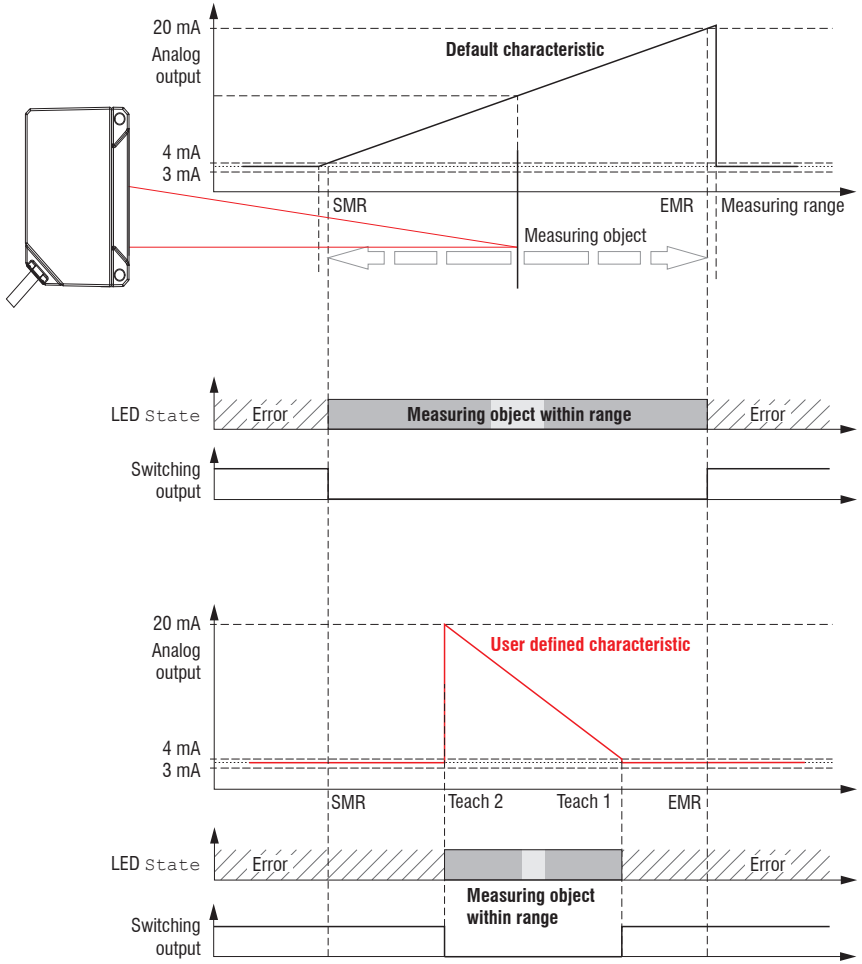


Fig. 29 Default characteristic (black), reverse, user defined characteristic (red)

7.5.2.2 Output Scaling with Key Select

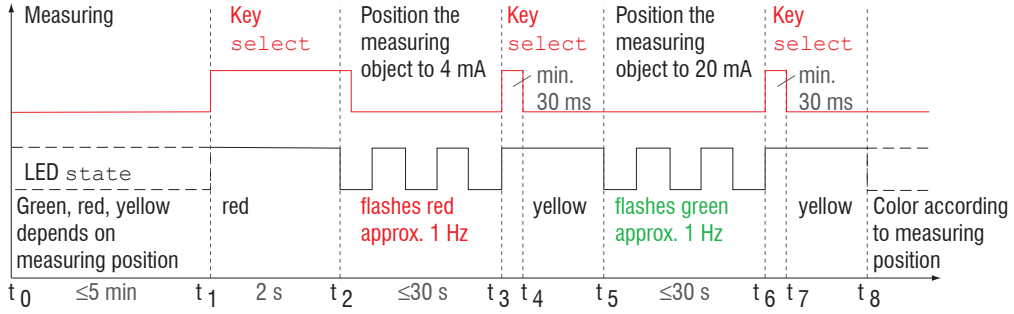


Fig. 30 Flow chart for output scaling

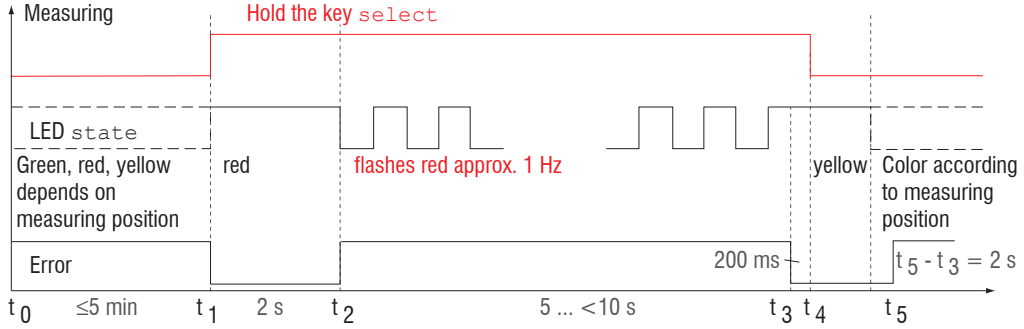


Fig. 31 Flow chart for the return of output scaling

If the key `Select` is pressed longer than 10 s or not within the timeframe while doing the return of the output scaling, an error is shown via `State` LED. In this case the `State` LED is blinking red with 8 Hz for 2 s.

7.5.2.3 Output Scaling via Hardware Input

Scaling of the analog output can be made via an impulse at the functional input, the violet wire on the sensor cable.

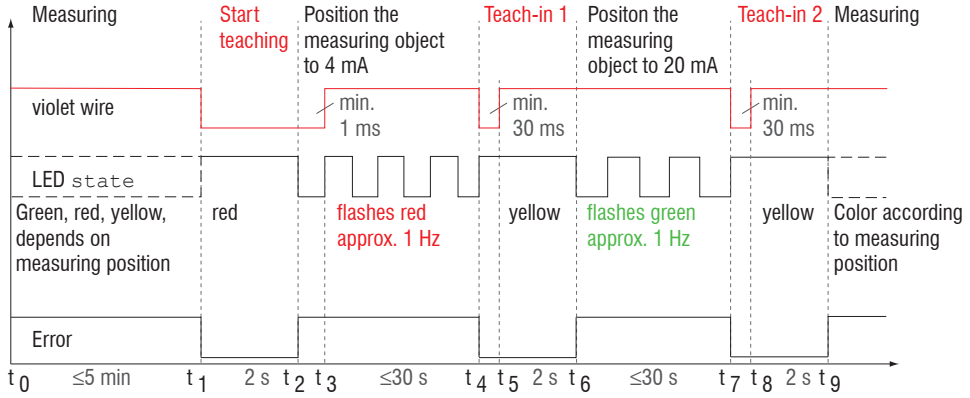


Fig. 32 Flow chart for output scaling

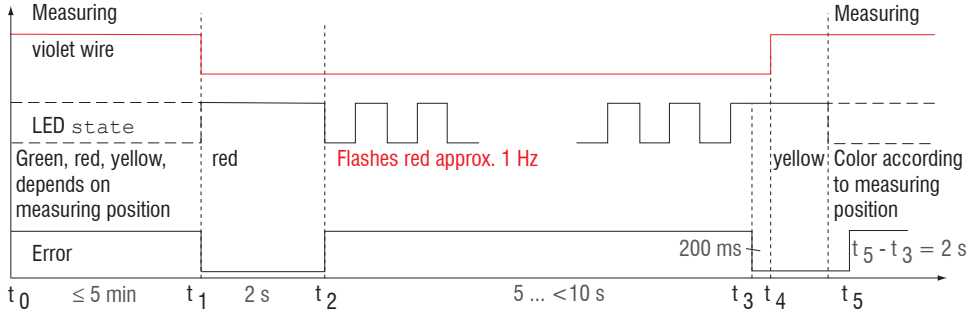


Fig. 33 Flow chart for the return of output scaling

7.5.2.4 Calculation of Measuring Value using Analog Current

Current output (without zeroing, without teaching)

Variables	Value range	Formula
I_{OUT} = current [mA]	[3,8; <4] SMR reserve [4; 20] measuring range [>20; 20,2] EMR reserve	$d\ [mm] = \frac{(I_{OUT}\ [mA] - 4)}{16} * MR\ [mm]$
MR = measuring range [mm]	{10/25/50/100/200/500}	
d = distance [mm]	[-0,01MR; 1,01MR]	

Current output (with zeroing), reference value is midrange

Variables	Value range	Formula
I_{OUT} = current [mA]	[3,8; <4] SMR reserve [4; 20] measuring range [>20; 20,2] EMR reserve	$d\ [mm] = \frac{(I_{OUT}\ [mA] - 12)}{16} * MR\ [mm]$
MR = measuring range [mm]	{10/25/50/100/200/500}	
ZP = zero position [mm]	[0; MR]	

Current output (with teaching)

Variables	Value range	Formula
I_{OUT} = current [mA]	[3,8; <4] SMR reserve [4; 20] measuring range [>20; 20,2] EMR reserve	$d\ [mm] = \frac{(I_{OUT}\ [mA] - 4)}{16} * \lvert n\ [mm] - m\ [mm] \rvert$
MR = measuring range [mm]	{10/25/50/100/200/500}	
m, n = teachig area [mm]	[0; MR]	
d = distance [mm]	[m; n]	

Current output (with zeroing and teaching)

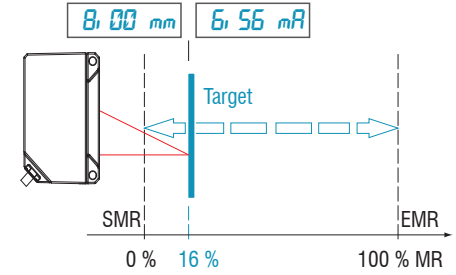
Variables	Value range	Formula
I_{OUT} = current [mA]	[3,8; <4] SMR reserve [4; 20] measuring range [>20; 20,2] EMR reserve	$d\ [mm] = \frac{(I_{OUT}\ [mA] - 12)}{16} * |n\ [mm] - m\ [mm]|$
MR = measuring range [mm]	{10/25/50/100/200/500}	
ZP = zero position [mm]	[0; MR]	
m, n = teaching area [mm] [1]	[0; MR]	
d = distance [mm]	[m; n]	

1) If one of the teach points (m, n) is outside the measuring range (MR) due to zeroing, the sensor outputs an error message.

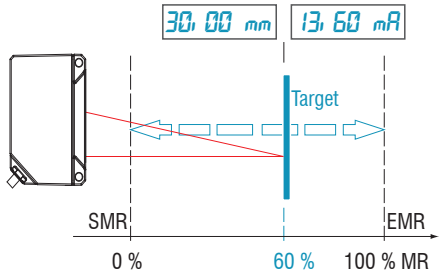
7.5.2.5 Characteristics Distance Value and Analog Output

The zero setting function set the analog output on half of the output range independent on the zero setting position, thus 12 mA. The examples below show the current output and the distance value behavior of an ILD1220-50 with 50 mm measuring range.

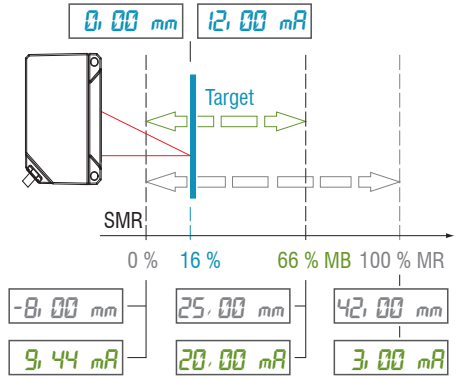
Target at 16 % measuring range



Target at 60 % measuring range

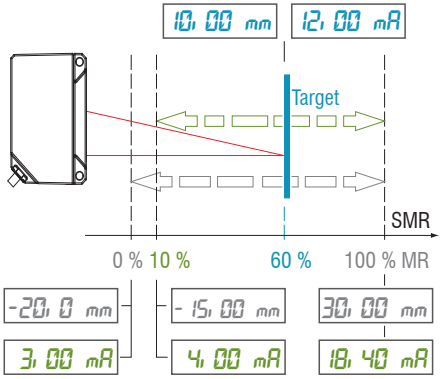


➡ Zero setting



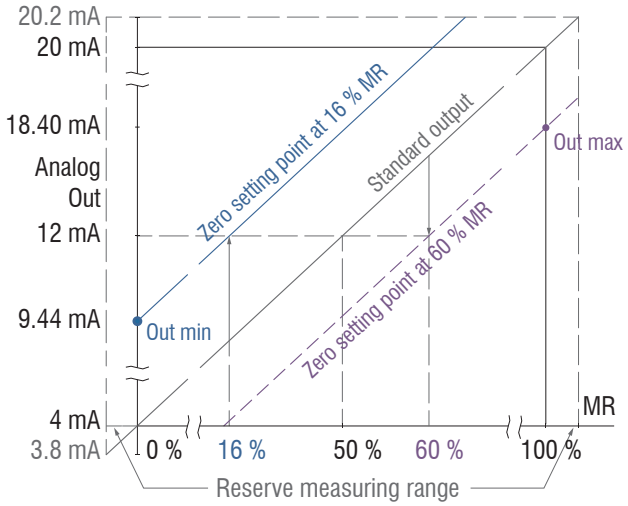
Analog maximum reached at 66 % MR

➡ Zero setting



Analog minimum reached at 10 % MR

MR = measuring range, SMR = start of measuring range, EMR = end of measuring range



Zero setting point	Out min	Out max
16 % (8 mm)	9.44 mA (-8 mm)	20.0 mA (33 mm)
60 % (30 mm)	4.00 mA (-15 mm)	18.40 mA (30 mm)

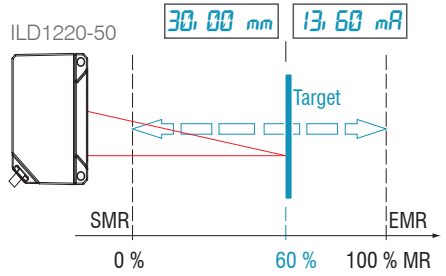
Fig. 34 Analog output with zero setting, measuring range 50 mm

7.5.2.6 Zeroing and Teaching Analog Output

Proceed as follows:

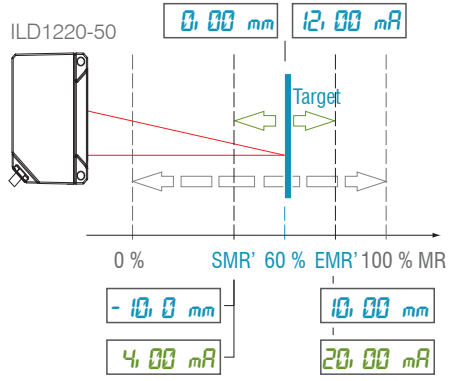
1. Zero setting, menu `Inputs`
2. Teach output, menu `Outputs`

The zero setting function set the analog output on half of the output range, see Chap. 7.5.2.5.



➡ Target at 60 %, zero setting

➡ Set minimum (m) 20 mm and maximum (n) 40 mm



i With n < m generates an inverse characteristic.

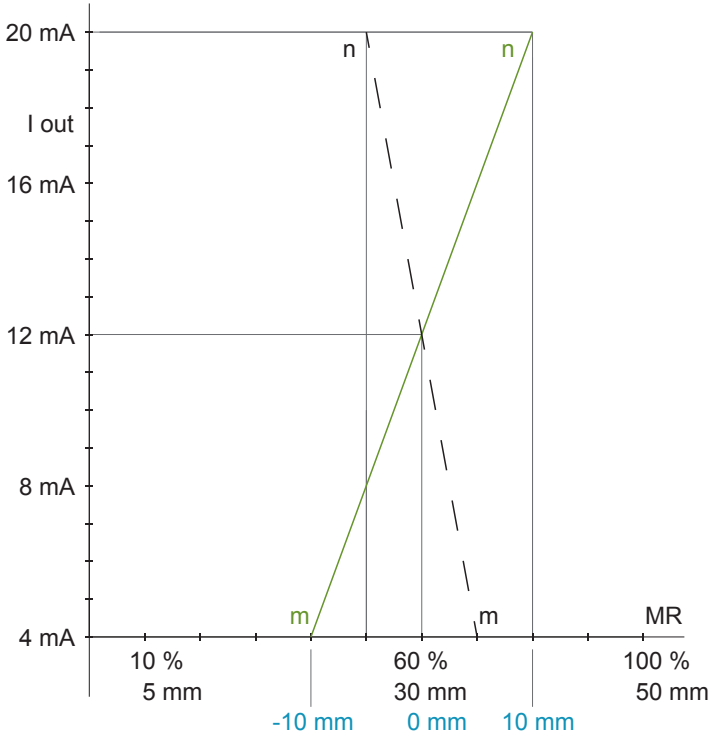


Fig. 35 Analog output characteristic after zero setting and scaling with an ILD1220-50

7.5.3 Switching Output

The switching output can be used for error or limit value monitoring of the output value.

`Measuring range`	Target outside the measuring range, target is absent or inappropriate target (too dark, metallic polished, insufficient reflection).
`Analog range`	If the distance is outside the scaled analog range, the switching output is activated.
`Limit value`	If the value exceeds a defined limit, the switching output is activated.

The switching output is activated depending on the set switching behavior, see Chap. 5.4.8.

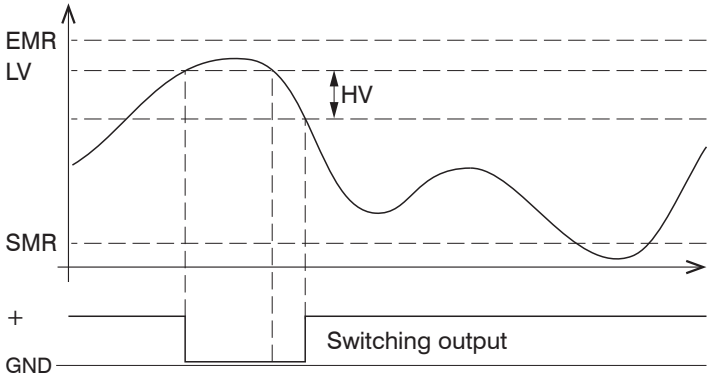


Fig. 36 Switching output with function limit value, switching behavior (NPN)

When exceeding the limit value, the switching output is activated (conductive) and is then deactivated again when the next hysteresis value is not reached.

The switching output with function `measuring range` or `limit value` is independent of the analog output.

EMR = End of measuring range
LV = Limit value
HV = Hysteresis value
SMR = Start of measuring range

7.6 System Settings

7.6.1 General

After programming all the settings are to be stored permanently in a set of parameters. The next time you turn on the sensor they are available again.

7.6.2 Unit, Language

The web interface promotes the units millimeter (mm) and inch when displaying measuring results.

You can choose German, English or Chinese in the web interface. You can change language in the menu bar.

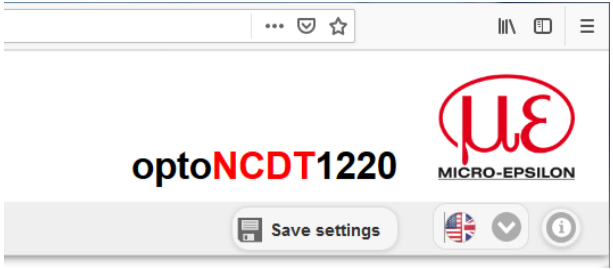


Fig. 37 Language selection in the menu bar

7.6.3 Keylock

The function keylock for the key `Select, see Chap. 5.3` prevents unauthorized / unintended performing of the key functions. Keylock is always activated when user level `User` is chosen. Keylock can only be deactivated in user level `Expert`. If an expert logs in the system, keylock on the sensor is automatically unlocked.

Key lock	*Automatic*	*Range from 1 ... 60 [min]*	Value	*Keylock starts after expiry of defined time. Clicking the button `Refresh` prolongs the timeframe until keylock starts.*
	Active			*The key `Select` is deactivated independent of the user level.*
	Inactive			*The key `Select` is active independent of the user level.*

Grey shaded fields require a selection.

Value — Dark-bordered fields require you to specify a value.

7.6.4 Load, Save

All settings to the sensor can be saved permanently in one application program, a so called setup.

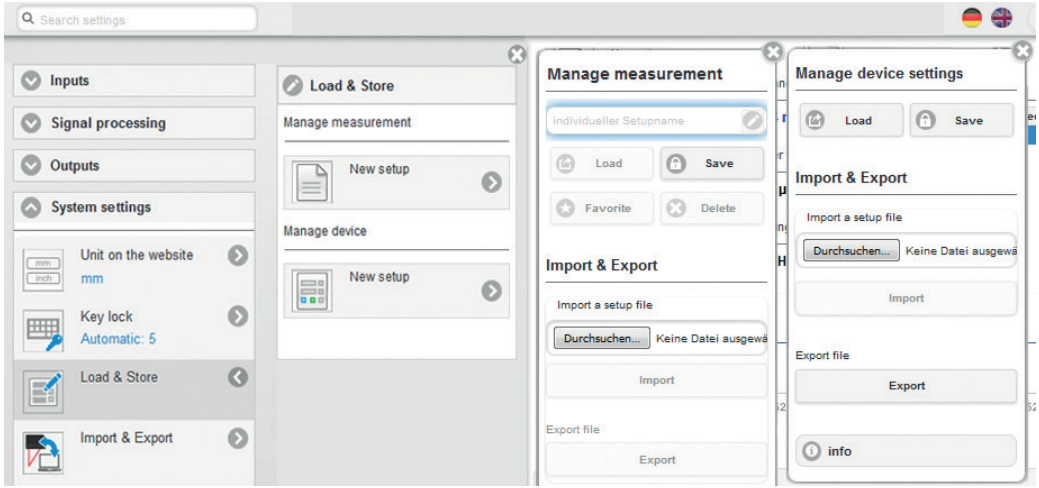
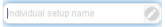


Fig. 38 Administration of application programs

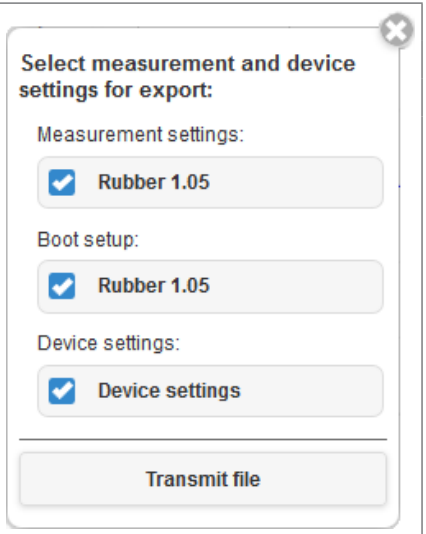
Administer setups in the sensor, possibilities and procedure			
Save settings	**Activate existing setup**	**Save changes in active setup**	**Define setup after booting**
Menu `New setup`	Menu `Load & Save`	Menu bar	Menu `Load & Save`
➡ Enter the name for the setup into the field  , e.g. `rubber 1.05` and click the button `Save`.	➡ Click on the setup with the left mouse button. The dialog `Setup management` opens. ➡ Click on the button `Load`.	➡ Click on the button 	➡ Click on the setup with the left mouse button. The dialog `Setup management` opens. ➡ Click on the button `Favorite`.

Exchange setup with PC/notebook, possibilities	
Save setup on PC	**Load setup from PC**
Menu `Load & Save`	Menu `Load & Save`
➡ Click on the setup with the left mouse button, area A. The dialog `Setup management` opens. ➡ Click on the button `Export`.	➡ Click on `Create setup` with the left mouse button. The dialog `Setup management` opens. ➡ Click on the button `Search`. A Windows dialog for file selections opens. ➡ Choose the desired file and click on the button `Open`. ➡ Click the button `Import` in the setup management.

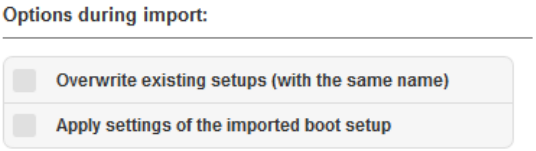
7.6.5 Import, Export

A set of parameters covers current settings, setup(s) and the initial setup when booting the sensor. The menu `Import & Export` enables easy exchange of sets of parameters with a PC/notebook.

Exchange set of parameters with PC/notebook, possibilities	
Save set of parameters on PC	**Load set of parameters from PC**
Menu `Import & Export`	Menu `Import & Export`
➡ Click on the button `New set of parameters` with the left mouse button. The dialog `Choose setups for export` opens. ➡ You arrange a set of parameters by selecting/deselecting the check boxes. ➡ Click on the button `Transmit file`. A Windows dialog for file transmission opens. ➡ Confirm the dialog with OK. The operating system stores the set of parameters in the area `Download`. File name for the following example is `<...\Downloads\ILD1220_50BASICSETTINGS_MEASSETTINGS_SCHALE_T1...SETTING_Rubber 1.05.JSON>`	➡ Click on the button `Search`. A Windows dialog for file selection opens. ➡ Choose the desired file and click on the button `Open`. The dialog `Choose setups for import` opens. ➡ You define actions to be made by selecting/deselecting the check boxes. ➡ Click on the button `Transmit file`.



A security query, see adjacent figure, helps to avoid that an existing setup is inadvertently overwritten during import.



7.6.6 Access Authorization

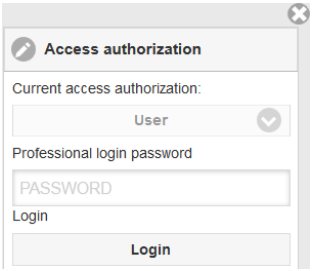
The assignment of a password prevents unauthorized changing of settings on the sensor.
When delivered, the password protection is not enabled. The sensor operates in the user level `Professional`. The password protection should be enabled after configuration of the sensor.
The default password for the expert level is `000`.

The default password or a user-defined password is not changed by a software update.
The professional password is independent of the setup and is therefore not together loaded or saved with the setup.

The following functions are available for the user:

	User	Professional
Password required	no	yes
Viewing settings, signal processing, outputs, system settings	yes	yes
Changing settings, signal processing, outputs, system settings	no	yes
Changing password	no	yes
Setting factory setting	no	yes

Fig. 39 Rights in the user hierarchy



Type in the default password `000` or a user-defined password in the `Password` field and confirm with `Login`.

Change with a click on the `Logout` button in the mode user.

Fig. 40 Change in the professional user level

The user management allows you to assign a custom password in the `Professional` mode.

Password	*Value*	*Case-sensitive rules are observed for all passwords. Numbers are allowed. Special characters are not allowed. Maximum length is set to 31 characters.*
User level when restarting	*User / Professional*	*Specifies the user level, with which the sensor starts after the re-starting. For this purpose, MICRO-EPSILON recommends the selection* `user`*.*

After configuration of the sensor the password protection is to be activated. Please note the password for later reference.

Grey shaded fields require a selection.

Value

Dark-bordered fields require you to specify a value.

8. Digital Interface RS422

The interface RS422 has a maximum baud rate of 1 MBaud. The factory-set baud rate is 921.6 kBaud.

Data format: Measurement values in binary format, commands as an ASCII string.

Interface parameter: 8 Data bits, no parity, one stop bit (8N1).

i Disconnect or connect the D-sub connection between RS422 and USB converter when the sensor is disconnected from power supply only.

9. Cleaning

Cleaning of the protective screens is recommended periodically.

Dry Cleaning

Therefore an optics anti-static brush is suitable or bleeding the screen with dehumidified, clean and oil-free compressed air.

Wet Cleaning

For cleaning the protective screen use a clean, soft, lint-free cloth or lens cleaning paper with pure alcohol (isopropyl).

Never use standard glass cleaner or other cleaning agents.

10. Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, MICRO-EPSILON or your dealer must be notified immediately.

The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to MICRO-EPSILON with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by MICRO-EPSILON.

Further claims can not be made. Claims arising from the purchase contract remain unaffected. In particular, MICRO-EPSILON shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, MICRO-EPSILON reserves the right to make design changes without notification.

For translations into other languages, the German version shall prevail.

11. Decommissioning, Disposal

➡ Remove the power supply and output cable from the sensor.

Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

12. Service, Repair

If the sensor or sensor cable is defective:

- If possible, save the current sensor settings in a parameter set, see Chap. 7.6.4, to reload them into the sensor after the repair.
- Please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire measuring system to:

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Lessingstraße 14
01465 Langebrück / Germany
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Fax +49 (0) 35201 / 729-90

optronic@micro-epsilon.de
www.micro-epsilon.com

Appendix

A 1 Optional Accessories

IF2001/USB		Converter RS422 to USB, type IF2001/USB, inclusive driver, connections: 1× female connector 10-pin (cable clamp) type Würth 691361100010, 1x female connector 6-pin (cable clamp) type Würth 691361100006
IF2004/USB		1 channel [1] converter RS422 to USB inclusive driver, connections: 1× terminal block
PS2020		Power supply for mounting on DIN rail, input 230 VAC, output 24 VDC/2.5 A

1) One channel with ILD1220 possible only.

A 2 Factory Settings

Password	„000“
Measuring rate	1 kHz
Measuring range	100 % FSO: I = 20 mA
	0 % FSO: I = 4 mA
Error handling	Error output, no measurement

Language	German
Output	Analog current
RS422	921.6 kBaud
Trigger mode	No trigger

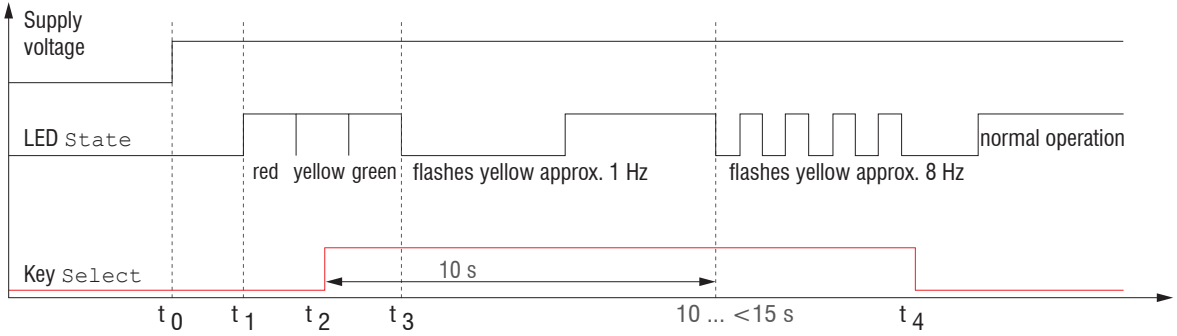

Fig. 41 Flow chart to start a sensor with factory setting

t_0: power supply is on

t_1 ... t_3: both LEDs signalize the start sequence (red-yellow-green for 1 sec. each)

t_2: key is pressed during start sequence (t_1 ... t_3)

t_4: key is released while the LED State is flashing yellow

$\Delta t = t_4 - t_2$; Δt (key press period) must be at least 10 sec., max. 15 sec.

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